

‘It’s okay to be white’ fliers found at MIT

No information on the responsible parties has been discovered yet

By Kaitlyn Hennacy
ASSOCIATE NEWS EDITOR

MIT’s Bias Response Team received four reports Nov. 1 of fliers with the slogan “It’s okay to be white,” which has been linked to white supremacist activism, posted near campus.

Fliers were seen on car windshields parked along Massachusetts Avenue, a traffic cone outside of Hayden Library, a lamppost on the east side of Mass. Ave., and a blue emergency light pole in front of Eastgate, Sarah Rankin, director of the Title IX and Bias Response Office, wrote in a statement sent to *The Tech* Wednesday.

The Tech also saw a partially torn “It’s okay to be white” flier on a sign outside Building E52 last Friday afternoon.

No information on the parties responsible for posting the fliers has been found, Rankin wrote.

According to the Anti-Defamation League (ADL), a Jewish organization based in the U.S., the act of posting these fliers near college campuses is a continuation of previous incidents. A post on the anonymous online forum 4chan in October 2017 encouraged users to hang up the fliers in an effort to arouse agitation, and another 4chan post called supporters to hang up posters the night of Oct. 31, 2018.

In its report, the ADL linked the 4chan posts to white supremacists and traced the “It’s okay to be white” phrase to white supremacist fliers as far back as 2005.

“White nationalist and other

Fliers, Page 2



ASSEL ISMOLDAYEVA - THE TECH

Eric Schmidt, who served as the Executive Chairman of Google from 2001 to 2015, hosted the ‘Engineering the Future We Want’ talk held on Nov. 7 in Stata Center.



IVANA ALARDIN—THE TECH

An “It’s okay to be white” flier was posted outside E52 as of last Friday.

Employees sue Happy Lamb Hot Pot in Central Square

Nine current and former employees of the Happy Lamb Hot Pot restaurant in Central Square are suing the restaurant for “failing to pay minimum wage and overtime, stealing workers’ tips, ignoring paid sick leave laws, and retaliating against employees,” according to a press release sent to *The Tech* by Greater Boston Legal Services, the firm representing the employees.

The employees, who worked as wait staff, bussers, hosts, and kitchen staff at Happy Lamb, are asking for \$806,000 to compensate for violations of state and federal wage and hour laws since the restaurant’s opening in 2016, the press release continued.

The complaint was filed Oct. 30 with the United States District Court in Massachusetts.

“We are waiting for the Defendants to respond to the workers’ Complaint and then we will go

through a scheduling process with the court,” Ting Chiu, staff attorney at Greater Boston Legal Services, wrote in an email to *The Tech* Wednesday.

“The timeline for wage theft lawsuits vary, but we hope that the Defendants understand the seriousness of the workers’ allegations and respond immediately,” Chiu continued.

Sean Zheng, a former employee of Happy Lamb, said in the press release that the restaurant managers took portions of employee tips for themselves and for family members (some of whom were also employed by Happy Lamb).

Zheng also claimed to Eater Boston that when his name was mentioned in a coworker’s conversation about the violations, Zheng’s manager began decreasing his hours “until there wasn’t any work for me to do.”

Huan Ning Huang, also a former employee of Happy Lamb, told *Eater* that he was injured while working there but was not permitted to take leave and so had to quit.

He also said that Happy Lamb uses “really, really intense bleach and detergents” to wash dishes and linens, and the chemicals caused him skin irritation, to the point where it felt as though he was “being burned by fire.”

The employees are also calling for a boycott of Happy Lamb.

“Students could play a huge role in making sure that the workers’ rights are enforced,” Chiu wrote. “The restaurant might not ultimately care about compensating the workers. But any business cares if it loses customers. To make sure restaurants don’t exploit workers, students can vote with their feet — and in this case their stomachs too!”

—Jessica Shi

Marvel’s Stan Lee dead at 95

Lee’s work helped to culturally legitimize comics

By Jonathan Kandell and Andy Webster
THE NEW YORK TIMES

Stan Lee, who as chief writer and editor of Marvel Comics helped create some of the most enduring superheroes of the 20th century and was a major force behind the breakout successes of the comic-book industry in the 1960s and early ’70s, died Monday in Los Angeles. He was 95.

Lee was for many the embodiment of Marvel, if not comic books

in general, and oversaw his company’s emergence as an international media behemoth. A writer, editor, publisher, Hollywood executive and tireless promoter (of Marvel and of himself), he played a critical role in what comics fans call the medium’s silver age.

Many believe that Marvel, under his leadership and infused with his colorful voice, crystallized that era, one of exploding sales, increasingly complex characters and stories, and growing cultural legitimacy for the

medium. (Marvel’s chief competitor at the time, National Periodical Publications, now known as DC — the home of Superman and Batman, among countless other characters — augured this period, but did not define it, with its 1956 update of its superhero the Flash.)

Lee was a central player in the creation of Spider-Man, the X-Men, the Fantastic Four, Iron Man, the Hulk, Thor and the many other su-

Stan Lee, Page 2

IN SHORT

Spring housing forms are due Nov. 25 and are available at <http://myhousing.mit.edu>.

Shuttle service from the Kresge parking lot to Logan Airport is provided next Monday, Tuesday, and Wednesday for the Thanksgiving break at scheduled departure times. Reservations are required, and the cost is \$15.

The deadline to drop a full-term subject is Nov. 21, next Wednesday. Changes from credit to listener must also be made by this date. Talk to your advisor if you plan

to drop a class, and remember to submit the form again after their approval. Half-term subjects offered in the second half of the semester may be dropped through Nov. 28.

There are no classes on Thursday, Nov. 22 or Friday, Nov. 23 due to the Thanksgiving vacation. Happy Turkey Day!

Interested in joining *The Tech*? Stop by for dinner Sunday at 6 p.m. or email join@tech.mit.edu.

Send news and tips to news@tech.mit.edu.

BEND AND CLAP

MTG performs the now-classic musical *Legally Blonde*.

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STEALING CHRISTMAS... AGAIN

The Grinch gives a new take on the old story, with fresh music. ARTS, p. 3

PIRATES HO!

The story of Peter before Neverland. ARTS, p. 3



HUMANS WITHOUT HUMANITY

El Angel tells a hedonistic tale of crime, nature and nurture. ARTS, p. 4

DISEASES AT THE NANOSCALE

The Nanomechanics Lab investigates red blood cell diseases. SCIENCE, p. 8

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The Tech (ISSN 0148-9607) is published on Thursdays during the academic year (except during MIT vacations) and monthly during the summer by The Tech, Room W20-483, 84 Massachusetts Avenue, Cambridge, Mass. 02139. Subscriptions are \$50.00 per year (third class). **POSTMASTER:** Please send all address changes to our mailing address: The Tech, P.O. Box 397029, Cambridge, Mass. 02139-7029. **TELEPHONE:** Editorial: (617) 253-1541. Business: (617) 258-8324. Facsimile: (617) 258-8226. *Advertising, subscription, and typesetting rates available.* Entire contents © 2018 **The Tech**. Printed by Turley Publications, Inc.

WEATHER

First taste of winter

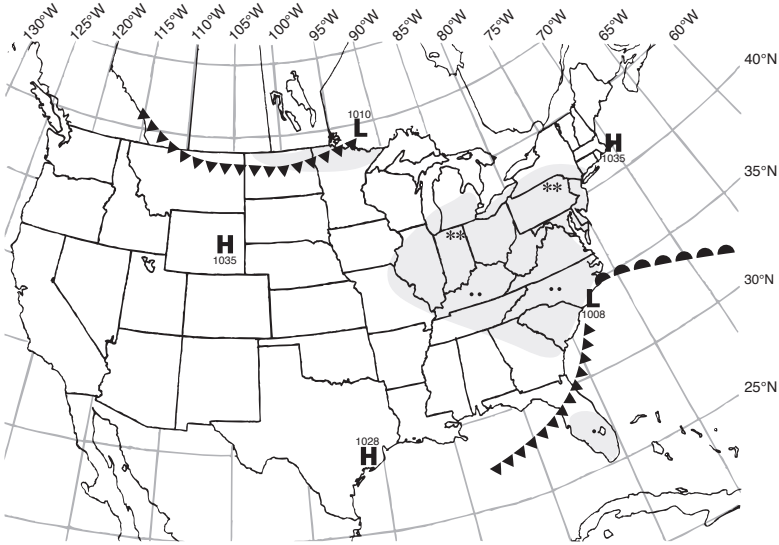
By Reagan Zimmerman

It's time to break out the hats and gloves for the weather today and tomorrow. Yet another nor'easter will move in from the south tonight, this time bringing a chance of accumulating snow. Overnight, the snow will turn to rain as warm air moves in before a slight increase in temperatures for the weekend. Saturday and Sunday will feature sun-

ny skies with highs in the mid 40s °F and dry weather — a welcome relief from Boston's exceptionally wet fall. On the other side of the United States, wildfires continue to rage through California where over a 100 people have gone missing and nearly 50 have been reported dead. Firefighters continue to battle the three separate blazes across the state, fueled by an anomalously dry year and windy conditions.

Extended Forecast

Today: Increasing clouds. High around 34 °F (1 °C). Light winds.
Tonight: Snow in the evening, turning into rain overnight. Light snow accumulation possible. Overnight low around 33 °F (1 °C). Winds from the east around 15 mph.
Tomorrow: Rainy and breezy. High of 43 °F (6 °C), low of 30 °F (-1 °C). Winds from the north around 15 mph.
Saturday: Sunny with clear skies. High near 47 °F (8 °C), low near 33 °F (1 °C).
Sunday: Sunny with clear skies. High near 43 °F (6 °C).



Weather Systems	Weather Fronts	Precipitation Symbols	Other Symbols
H High Pressure	Trough	Snow	Fog
L Low Pressure	Warm Front	Rain	Thunderstorm
Hurricane	Cold Front	Light	Haze
	Stationary Front	Moderate	
		Heavy	

Situation for Noon Eastern Time, Thursday, November 15, 2018

Lee in 2010 about future projects: ‘I just wish there were more time’

Stan Lee, from Page 1

perheroes who, as properties of Marvel Comics, now occupy vast swaths of the pop culture landscape in movies and on television.

Under Lee, Marvel revolutionized the comic book world by imbuing its characters with the self-doubts and neuroses of average people, as well as an awareness of trends and social causes and, often, a sense of humor.

In humanizing his heroes, giving them character flaws and insecurities that belied their supernatural strengths, Lee tried “to make them real flesh-and-blood characters with person-ality,” he told The Washington Post in 1992.

“That’s what any story should have, but comics didn’t have until that point,” he said. “They were all cardboard figures.”

Energetic, gregarious, optimistic and alternately grandiose and self-effacing, Lee was an effective salesman, employ-

ing a Barnumesque syntax in print (“Face front, true believer!” “Make mine Marvel!”) to market Marvel’s products to a rabid following.

Though Lee was often criticized for his role in denying rights and royalties to his artistic collaborators, his involvement in the conception of many of Marvel’s best-known characters is indisputable.

The quintessential Lee hero, introduced in 1962 and created with artist Steve Ditko (1927-2018), was Spider-Man.

A timid high school intellectual who gained his powers when bitten by a radioactive spider, Spider-Man was prone to soul-searching, leavened with wisecracks — a key to the character’s lasting popularity across multiple entertainment platforms, including movies and a Broadway musical.

Lee moved to Los Angeles in 1980 to develop Marvel proper-ties, but most of his attempts at live-action television and movies were disappointing. (The se-ries “The Incredible Hulk,” seen

on CBS from 1978 to 1982, was an exception.)

In 2001, Lee started POW! Entertainment, but he received almost no income from Marvel movies and TV series until he won a court fight with Marvel Enterprises in 2005, leading to an undisclosed settlement costing Marvel \$10 million.

Lee’s unwavering energy suggested that he possessed superpowers himself. (In his 90s he had a Twitter account, @TheRealStanlee.) And the National Endowment for the Arts acknowledged as much when it awarded him a National Medal of Arts in 2008. But he was frustrated, like all humans, by mortality.

“I want to do more movies, I want to do more television, more DVDs, more multi-sodes, I want to do more lecturing, I want to do more of everything I’m doing,” he said in “With Great Power ...: The Stan Lee Story,” a 2010 television docu-mentary. “The only problem is time. I just wish there were more time.”

Fliers also seen at Tufts

Fliers, from Page 1

racist ideologies have no place at MIT ... and they are at complete odds with MIT’s openness to talent from every faith, culture, nation, and background,” Rankin wrote.

“It’s okay to be white” fliers were found on other college cam-puses, including Tufts and Duke University, around the same time.

The Tufts Daily reported Nov. 1 that fliers appeared on signs around campus encouraging stu-dents to vote, and *The Chronicle*, Duke’s student newspaper, report-ed the same day that fliers were discovered around their dorms. A pumpkin carved with a swastika was found at Duke along with the fliers.

The timing of the incident fell on the anniversary of a similar oc-currence that happened last year. *The Boston Globereported* stickers saying “It’s okay to be white” be-ing posted in Cambridge Common and Harvard Square Nov. 1, 2017.

The fliers appeared the week-end before Election Day. *Ivana Alardin contributed reporting.*

Solution to Labrador

from page 6

6	1	7	8	4	2	5	9	3
9	8	3	5	7	6	1	4	2
2	5	4	9	3	1	8	7	6
4	9	8	1	2	7	3	6	5
7	2	6	4	5	3	9	8	1
1	3	5	6	8	9	7	2	4
3	7	1	2	6	8	4	5	9
8	4	2	3	9	5	6	1	7
5	6	9	7	1	4	2	3	8

Solution to Special

from page 7

4	2	7	6	5	3	9	8	1
2	9	5	4	3	1	7	6	8
8	6	2	1	9	7	4	3	5
5	3	8	7	6	4	1	9	2
3	1	6	5	4	2	8	7	9
6	4	9	8	7	5	2	1	3
9	7	3	2	1	8	5	4	6
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7	5	1	9	8	6	3	2	4

Solution to Samoyed

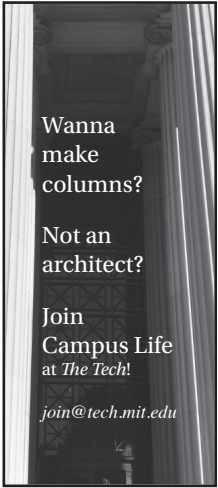
from page 6

2	4	3	6	5	1
3	5	4	1	6	2
4	6	5	2	1	3
5	1	6	3	2	4
1	3	2	5	4	6
6	2	1	4	3	5

Solution to Bartender

from page 6

N	L	P	S		P	A	S	S	P	A	L	E
N	O	A	H		O	M	I	T	A	L	I	N
A	S	I	A		I	S	L	E	P	A	N	D
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A	S	S	E	R	T		N	A	R	R	O	W
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M	I	T	T		T	O	O	T	A	B	O	D
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L	A	T	E		M	E	A	N		E	G	O
E	S	S	A		S	E	T	S		E	E	R



CORRECTIONS

The date of MITHenge was mistakenly reported as Friday in last week’s In Short. It is actually visible for sev-eral days: Saturday, Sunday, and Monday.

Be a PENguin

write for us
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We seek an energetic, enthusiastic, and well-orga-nized person for the position of Office Administrator/ Clerical part time .

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Carlos Robledo Puch goes from simple thief to serial killer

**Starring Lorenzo Ferro,
Chino Darín, Mercedes
Morán, Daniel Fanego**

A man with curly brown hair and sunglasses, wearing a black leather jacket with a fur collar, is riding a motorcycle. A woman with long blonde hair is sitting behind him, her hair blowing in the wind. They are both looking forward. In the background, there is a large concrete dam with multiple pillars, situated behind a body of water and some greenery. The scene is captured in a cinematic style with warm lighting.

Carlos is lighthearted about the crimes he commits. The first time he robs a gun store, he runs back to grab the bullet packages, risking their operation simply for the thrill of a good haul. While robbing a jewelry store, Carlos playfully puts on earrings stolen from a jeweler and comments that he looks like his mother, giving seductive glances to Ramón, his exasperated partner in crime. But *El Angel* is darkly comedic film steeped in the erotic. After bringing their bounty to a hotel, we see a nude Ramón covered by a towel laying on a bed. In an uncomfortable, intimate moment, Carlos peels the towel away and slowly covers Ramón's groin with the stolen jeweled necklaces.

A group of students in school uniforms (white shirts and purple vests) are singing from music books in a choir. They are standing in rows, and the focus is on a student in the foreground who is looking down at her music book. The background is slightly blurred, showing other students and a bright, indoor setting.

Nov. 3–4

OPERA REVIEW

When a lumberjack turns into a doctor in rural France...

A farce about the medical profession of 17th century France

Le Médecin Malgré Lui

**Composed by Charles
François Gounod**

**Libretto by Jules Barbier
and Michel Carré**

Huntington Avenue Theater

Nov. 9–11

By Sophia Chan
STAFF WRITER

As a celebration of the 200th anniversary of Charles Gounod's birth, the Odyssey Opera presents this opéra-comique while also preserving original text from Molière's play. Sung in French and paired with English subtitles, the opera features never-before heard recitatives by Erik Satie. Serving to frame the atmosphere of the opening act, the overture performed by the background orchestra was in the major key. It was both cheeky and energetic; the percussion added a special effect.

The plot is split into three separate acts. In the first, an alcoholic lumberjack named Sgnarabelle treats his wife, Martine, extremely poorly. When she's left alone to her own thoughts, Martine seeks to plot the most ill-willed revenge against her husband. All of a sudden, two servants of the wealthy G ron te by the name of Val re and

Lucas cross paths with Martine, in search of a doctor for their master's daughter, Lucinde. It is later revealed that she feigns the illness the entire time in order to avoid a marriage that her father has set up for her. Martine tells the servants that her husband is the best doctor around, but one that refuses to practice his medicine unless beaten to confession. When they find Sgnarrelle in the woods, they thrash him and bring him back to their master's home.

In the following act, Sgnararelle is ironically treated like royalty when he is received in the G ronte household. Then, Lucinde's true lover, L andre, sings an emotional serenade on both the power and pains of love. G ronte hears this and then continues to complain to the nursemaid, Jacqueline, about how he has arranged for Lucinde to marry a rich husband, yet his efforts are unappreciated. When Sgnararelle begins to diagnose Lucinde's "disease," he states the obvious and provides nonsensical treatments but still impresses the entire household.

In the final act, Sgnararelle employs Léandre as his apothecary in order to return to Géronte's house. He admits to Léandre that he isn't a true doctor and helps distract the Géronte household and arrange for Léandre to elope with Lucinde. When the "doctor" and his "apothecary" return, Lucinde instantly regains her speech abilities, which infuriates Géronte as he realizes the truth behind the matter. Just as Géronte summons a police officer to hang Sgnararelle, Lucinde and her lover arrive to the scene and announce that Léandre has recently inherited a fortune, which prompts Géronte to approve of their marriage. Sgnararelle is freed at last and the entire group celebrates.



KATHY WITTMAN

The ensemble sings together in *Le Médecin Malgré Lui*.

Stylistically speaking, I found both the costumes, staging, and props very appropriate to the time period portrayed. Everything emulated the French revolutionary aura. The flute melody in between Act I and II was also unique in its sound, arousing curiosity leading into the next part of the plot. In terms of vocal and stage performance, the vocal harmony presented by the cast proved to be highly impressive. Whitney Robinson (who portrayed Martine)'s solo stood out in terms of how comical her message was and the power

her vocal quality demonstrated. One thing I would like to point out, though, was that during certain choruses, some of the casts' dancing was off-beat from the orchestral accompaniment. However, it is important to note that the cast had to handle much physical movement while singing operatically, especially Stephen Salters (Sgnararelle).

With this opera being the first one I've seen, I very much enjoyed its entertainment value and its skepticism of the medical practice in 17th century France.

THEATER REVIEW

Bend and clap!

MTG's rendition of *Legally Blonde: The Musical* is fun, entertaining, and self-contained



COURTESY OF JULIE HENION PHOTOGRAPHY

Warner Huntington III (Nicholas Freitas '21) sings "Serious" during his date with Elle Woods (Maia Campbell '22).

By Rogers Epstein

After the original movie came out in 2001, *Legally Blonde* has made it to MIT in musical form. While I know many of the references, I went into this performance having never seen the original material. Thanks to the script, there is no need to know anything about the movie in order to appreciate the show.

The musical begins with Elle Woods (Maia Campbell '22) and her Delta Nu sorority sisters excitedly preparing for Elle's boyfriend, Warner Huntington III (Nicholas Freitas '21), to propose to her that night.

However, Warner takes an emotional turn and dumps her instead in order to pursue his dream of being a politician by going to Harvard Law School. To be with him, Elle chooses to study to get into law school. This leads to a very timely scene where Elle interacts with Harvard admissions counselors and convinces them to let her not only to help with “diversity,” but also to pursue love. While one of the more unusual scenes in the play, it was one of the most enjoyable. With the context of the Harvard Admissions court case, it’s nice to imagine Elle’s innocence and eagerness permeating both her application and the show itself.

After getting into Harvard, Elle has to confront the real reason she's there. Warner already has a new girlfriend, Vivienne Kensington (Cassidy Flakiewicz '22), and Elle doesn't fit in with her hilarious caricatures of Harvard classmates. Professor Callahan (Geoff Hegg '17) is cast perfectly and conveys the aura of a smug law professor who acts as a needed foil for Elle's initial over-enthusiasm. After a pep talk from the amazingly well-played and -voiced hairdresser Paulette Bonafonte (Carina Masuelli '22), and another from the endearing upperclassman Emmett Forest (Michael Mandanas '22), Elle works her way to the top of her class.

The four top students, which of course include Elle, Warner, and Vivienne, get to assist Callahan in defending Brooke Wyndham (Cecilia Esterman '21) against murder accusations. Brooke gets to introduce herself as a workout instructor during the most impressive dance number of the musical, in which the dancers synchronously jump rope while singing.

As the plot thickens, the musical isn't afraid to develop side characters further. Elle helps Paulette gain more dating confidence through the "bend and snap" maneuver, and in another scene she takes Emmett shopping to help him dress the part of an attorney. It's moments like these that remind the audience of Elle's inherently kind nature, and no matter how her goals keep changing through the narrative, she stays true to herself.

The musical ends with Elle outing two witnesses for perjury through her knowledge of straight men and hair, thus winning the case. While this musical is overall a happy one, the script knows to introduce story elements that contrast with this. Moments like when Warner proposes to Vivienne or when Callahan makes an unwarranted advancement on Elle remind the audience that Elle faces a lot of

Legally Blonde

Directed by Phoebe Piercy '20

**Performed by the MIT
Musical Theater Guild**

**Music by Laurence
O’Keefe and Nell
Benjamin**

La Sala de Puerto Rico, Student Center

**Nov. 9–10, 15–17 at 8 p.m.,
Nov. 11 at 2 p.m.**

obstacles that can't be overcome with a smile. In the case of the latter example, this moment helps Vivienne see Elle as she truly is: an intelligent woman who is treated unfairly due to her looks. This change was one of the most unexpected but welcome character developments, veering from the easy trope of keeping Vivienne as the "mean girl."

Overall, this musical provided more details and character arcs than one would expect. While there was always something to follow, the performance prioritizes being fun and enjoyable. This is hit over the head when Elle's happy mind, personified as her "Greek Chorus," berates various scenes with positivity. To balance Elle's battles with sexism, the musical incorporates gleeful stereotypes to keep in theme, exemplified by the song "Gay or European." There is a lot to appreciate in this show, but no matter what, you'll be sure to appreciate it if you go.

Solution, page 2

Instructions: Fill in the grid so that each column, row, and 3 by 3 grid contains exactly one of each of the digits 1 through 9.

Solution, page 2

Instructions: Fill in the grid so that each column and row contains exactly one of each of the numbers 1–6. Follow the mathematical operations for each box.

Solution, page 2

- 1 Stereo records: Abbr.
- 4 Football throw
- 8 Not as tanned
- 13 Biblical boat builder
- 14 Fail to mention
- 15 Drop __ to (write)
- 16 India's continent
- 17 Spot of land in the ocean
- 18 Black-and-white bear
- 19 Give a formal warning
- 22 "In __ we trust" (US motto)
- 23 State with confidence
- 24 Becomes less wide
- 26 Egyptian snakes
- 29 "__ do you think you are?"
- 30 Catcher's glove
- 34 Whistle sound
- 36 "Humble" residence
- 40 Be discouraging about
- 43 Coffee sweetener
- 44 Wild animal's home
- 45 Sesame __ bun
- 46 Household cat or dog
- 48 Break sharply
- 50 Rubdown at a gym

59 Had a meal
60 Get confused
63 Piece of dinnerware
65 Region
66 Pro __ (proportionally)
67 In a little while
68 Have in mind
69 Self-images
70 Opinion piece
71 Complete collections
72 Suffix for racket or auction

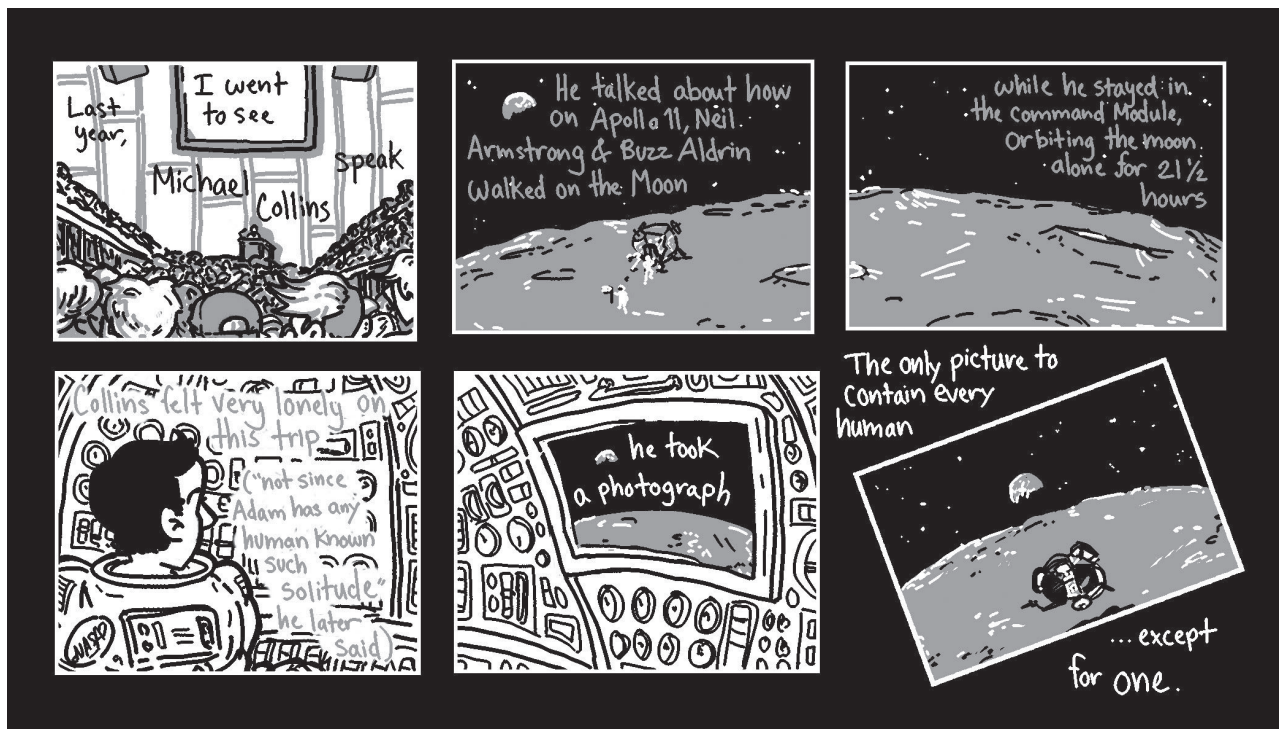
- 1 Misplaces
- 2 Groups of two
- 3 Remove whiskers
- 4 Indicates with one's index finger
- 5 "Are not!" response
- 6 River sediment
- 7 Beer mug
- 8 New Year's Eve party headgear
- 9 Pie __ mode
- 10 Specialized slang

funding for
12 Enjoys a book
13 Astronauts' agcy.
20 Historical period
21 Crow's sound
25 After-bath garments
27 Opinion survey
28 Ginger ale and cola
30 Army cops, for short
31 Written promise to pay
32 Harbor boat
33 Ensnares
35 Exact duplicate
37 Rock that's mined
38 Female deer
39 Put a stop to
41 Butter production factory
42 Saudis, for example
47 ___ Fridays (restaurant chain)
49 Pigsty
50 Source for pancake syrup
51 Book of maps
52 Chairs and benches
53 School tests
55 Have the same opinion

56 Customary practice	61 Elm or oak
57 Private instructor	62 What radiators give off
58 Resorts with hot springs	64 Coffee alternative

Greenhouse Affect

by Mehitabel Glenhaber

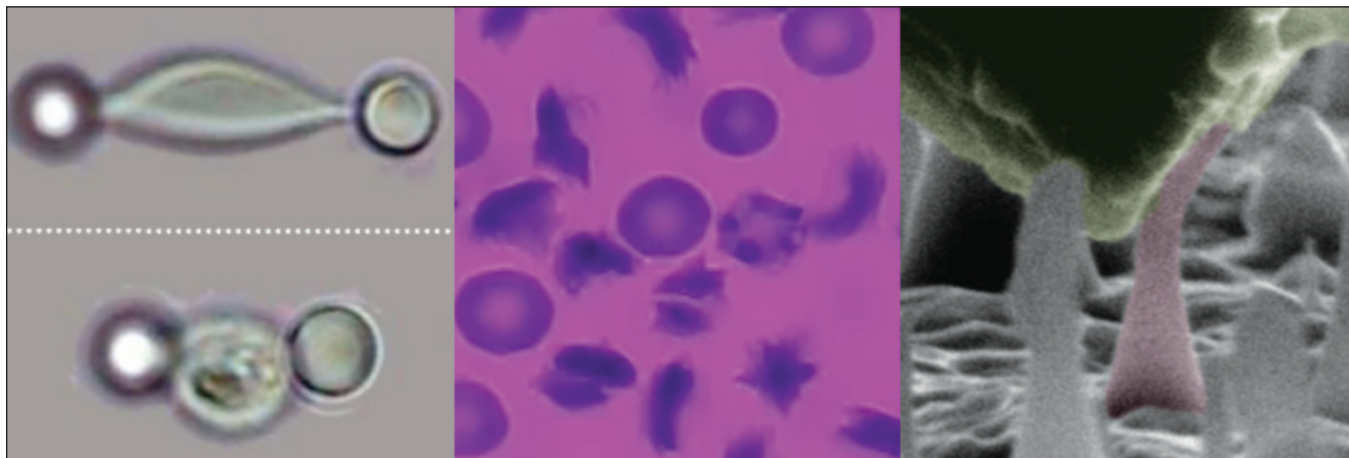


Researchers at the Nanomechanics Lab investigate the progression of red blood cell diseases with unique tools

Sickle cell disease is an inherited disease where red blood cells narrow and resemble a “C” shape. Under low-oxygen conditions, the sickled cells block small blood vessels, leading to excruciating pain and even other complications like stroke. In sickle cell disease and other diseases of red blood cells, securing a firm understanding of the problem itself is necessary to finding a solution that will help individuals with the disease. To this end, researchers at the Nanomechanics Laboratory strive to use the mechanical properties of nanomaterials to study the progression of and to understand the mechanisms of sickle cell disease and other life-threatening diseases.

Much of the current research at the Nanomechanics Laboratory has been geared towards diseases that involve red blood cells such as malaria and sickle cell anemia. The most lethal strain of malaria is caused by the parasite *Plasmodium falciparum*. The lab has been using microfluidics and different biomechanics tools such as optical tweezers and the Atomic Force Microscope (AFM) to understand the disease. Cells that become infected with malaria increase in rigidity as the disease progresses. These stiff cells clog microcirculation and hinder their own passage through spectrin networks of red blood cells that screen and filter old cells. They go on to adhere to locations in the tissue, giving rise to many more infected cells. Since each ligament of the spectrin network is around 75 to 80 nanometers in size, it is best to study the inner workings of malaria at the nanoscale.

According to Dao, current drugs for malaria have unwanted side effects, so it is especially important to understand the disease's foundations. "Antimalarial drugs



COURTESY OF MING DAO AND THE NANOMECHANICS LAB

Ming Dao and the Nanomechanics Lab have developed and used tools to study malaria, sickle cell disease, and nanoscale diamonds. Left to right: Optical tweezers stretching a healthy (upper) and malaria infected (lower) red blood cell, red blood cells sickling under low oxygen conditions, and a diamond nanoneedle bending.

help to cure the malaria-infected cells, but they stiffen the uninfected cells, causing anemia... Gaining a more accurate understanding of the disease can improve these drugs," says Ming Dao, the principal investigator and director of the Nanomechanics Laboratory.

Tools like optical tweezers use a focused laser beam to trap small particles. The laser beam can trap two particles on either side of a red-blood cell, and the time that the laser beam takes to travel precisely measures the distance traveled inside the cell. However, this distance fluctuates for each cell, giving the measurement of the cell's rigidity and stiffness.

The researchers at the Nanomechanics Lab have been studying the mechanisms of sickle cell disease by measuring the kinetics of mimicking the conditions of transient hypoxia — the low-oxygen conditions that cause sickling. The oxygen partial pres-

sure in the microfluidic device can be controlled to study the process of sickling. For example, the oxygen levels can be reduced to observe the gradual sickling of the cells. However all cells are different, so some cells sickle faster and some slower, and when the oxygen levels are raised back to normal, the cells quickly un-sickle. Using microfluidic tools, Dao and the researchers at the Nanomechanics Lab are able to learn about the rates of sickling among red blood cells.

In addition to allowing researchers to investigate minute changes in cells, nanomaterials allow for innovation in drug delivery. In the recent *Science* paper "Ultra-large Elastic Deformation of Nanoscale Diamond," Dao and his colleagues revealed that a nanoindenter can bend a diamond nanoneedle. This property of diamonds at the nanoscale makes them ideal for cellular drug delivery because drugs can be safely injected into cells without damage.

"We don't expect diamonds to bend this much, but diamonds at the nanoscale become very flexible but still strong," says Dao.

Dao and his team at the Nanomechanics Lab are now investigating the applications of nanomaterials to medicine further. "Each person is different, so research in precision medicine can help personalize drugs and maximize the effectiveness of the drug on the patient," says Dao. He is particularly excited by the new resolution and perspective that nanomechanics provides to research. "It is fascinating to study cell mechanics of diseases, because one can often visually see what is going on directly with all the latest nanomechanics tools," Dao says. Studying cell mechanics at the nanoscale provides a detailed look into disease progression and helps researchers like Dao pinpoint treatment targets that attack the root of a disease.

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